Chapter 5 – Molecules and Compounds

- Chemical Formulas
- Atomic/Molecular Elements
- Ionic/Molecular Compounds
- Naming Ionic Compounds
- Naming Molecular Compounds
- Naming Acids
- Formula Mass

Atomic / Molecular Elements



Atomic Element: Elements that exist in nature with single atoms as their base unit.

Molecular Elements: Elements that exists as diatomic molecules in nature

Examples:

 H_2 , N_2 , O_2 , F_2 , Cl_2 , Br_2 , and I_2



compounds

Naming Ionic Compounds

NaCl formula unit

An ionic solid consists of an array of cations and anions stacked together. This illustration shows the arrangement of sodium cations (Na⁺) and chlorine anions (Cl⁻) in a crystal of sodium chloride.

Cation: A positively charged ion

Anion: A negatively charged ion

Naming Ionic Compounds

Naming Cations

Rule 1: Monatomic cations have the same name as the element.

Examples:

 Na^+ s Mg^{2+} r

sodium ion magnesium ion

Note: Your book calls these type I ionic compounds

Naming Ionic Compounds

Naming Cations

Rule 2: For elements that form more than one cation, the oxidation number (the charge on the cation) is written in Roman numerals within parentheses following the name.

Examples:

Fe2+iron(II) ionFe3+iron(III) ion

Note: This rule is necessary for most transition metals Your book calls these type II ionic compounds

Naming Ionic Compounds

Monatomic anion

Rule 1: Named by adding the suffix –ide to the "stem" of the name

Examples: Cl⁻ chloride ion I⁻ iodide ion

Naming Ionic Compounds

Rule 1: Cation is named first followed by the anion Note: leave the word ion off when naming a compound

Example:

K ⁺	potassium ion
Cl	chloride ion
KCl	potassium chloride

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Rule 2: The oxidation of the cation is given if more than one charge is possible



Naming Ionic Compounds



Naming Ionic Compounds

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Name	Formula	Name	Formula
acetate	$C_2H_3O_2^-$	hypochlorite	ClO ⁻
carbonate	CO_3^{2-}	chlorite	ClO_2^-
hydrogen carbonate (or bicarbonate)	HCO ₃ ⁻	chlorate	ClO ₃ ⁻
hydroxide	OH ⁻	perchlorate	ClO_4^-
nitrate	NO ₃ ⁻	permanganate	MnO_4^-
nitrite	NO ₂ ⁻	sulfate	SO_4^{2-}
chromate	CrO_4^{2-}	sulfite	SO_3^{2-}
dichromate	$Cr_2O_7^{2-}$	hydrogen sulfite (or bisulfite)	HSO_3^-
phosphate	PO4 ³⁻	hydrogen sulfate (or bisulfate)	HSO_4^-
hydrogen phosphate	HPO_4^{2-}	peroxide	O_2^{2-}
ammonium	NH4 ⁺	cyanide	CN ⁻

 TABLE 5.6
 Some Common Polyatomic Ions

If a polyatomic ion is present, substitute the name of the polyatomic ion for either the cation or the anion

Examples:

NH4Clammonium chlorideNaOHsodium hydroxide

Naming Ionic Compounds

Polyatomic anions containing oxygen (Oxoanions)

Rule 1: If only one oxoanion of an element exists, its name is formed by adding the suffix —ate to the stem of the name of the element.

Example:

 CO_3^{2-} carbonate ion

Rule 2: For elements that can form two types of oxoanions the ion with the larger number of oxygen atoms is given the suffix – ate and that with the smaller number of oxygen atoms is given the suffix –ite.

Examples:

 NO_2^- nitrite ion NO_3^- nitrate ion

Naming Ionic Compounds

Oxoanions

Rule 3: For elements that can form more than two kinds of oxoanions, the oxoanions with the smallest number of oxygen atoms is formed by adding the prefix hypo- to the - ite form of the name.

Example:

ClO- hypochlorite ion

The oxoanions with the largest number of oxygen atoms is formed by adding the prefix per- to the —ate form of the name.

Example:

 ClO_4^-

perchlorate ion

Naming Molecular Compounds

CO₂ molecules



Molecular compounds form when two or more nonmetals bond together to form electrically neutral molecules

The molecules bond together by sharing electrons so that each atom will have a complete octet

Since there is no charge transfer, it is important to denote the number of each type of atom present

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Nomenclature of Compounds

Naming Molecular Compounds

Rule 1: For simple inorganic molecules, put a Greek prefix in front of the name to indicate the number of each type of atom present.

Note: If there is only 1 atom present you do not need to include a Greek prefix. There are some exceptions to this rule; most notable CO carbon monoxide.

Rule 2: When naming common binary molecular compounds, name the element that occurs further to the right in the periodic table second with its ending changed to —ide.

Example:

 N_2O_5

- PCl₃ phosphorus trichloride
- N₂O dinitrogen oxide
- SF_6 sulfur hexafluoride
 - dinitrogen pentaoxide

Naming Molecular Compounds

TABLE D.2	Prefixes	Used
for Naming	Compou	ands

Prefix	Meaning
mono-	1
di-	2
tri-	3
tetra-	4
penta-	5
hexa-	6
hepta-	7
octa-	8
nona-	9
deca-	10
undeca-	11
dodeca-	12

Naming Molecular Compounds



Naming Acids

Naming Acids

Rule 1: Binary acids are named by adding the prefix hydro- and changing the ending of the name of the second element to -ic acid

Example:

HCl(aq) hydrocloric acidHF(aq) hydrofluoric acid

Note: If you have HCl(s) solid (not dissolved in water) it is called hydrogen chloride but once it is dissolved in water, HCl(aq), it is called hydrochloric acid

Nomenclature of Compounds

Naming Acids

Naming Oxoacids (An acid containing oxygen) Oxoacids are the parents of oxoanions

Example:

 $\begin{array}{c} H_2 SO_4 \rightarrow 2H^+ + SO_4^{-2-} \\ H_2 SO_3 \rightarrow 2H^+ + SO_3^{-2-} \end{array}$

Rule 1: In general -ic oxoacids are the parents of -ate oxoanions and -ous oxoacids are the parents of -ite oxoanions

Example:

 $H_2SO_4(aq)$ sulfuric acid $H_2SO_3(aq)$ sulfurous acid SO_4^{2-} sulfate ion SO_3^{2-} sulfite ion

Naming Acids

